

## PATENT COOPERATION TREATY

## PCT

## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

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Applicant's or agent's file reference 200313701 WO		<b>FOR FURTHER ACTION</b>		See Form PCT/IPEA/416
International application No. PCT/EP2005/051259		International filing date (day/month/year) 17.03.2005		Priority date (day/month/year) 20.03.2004
International Patent Classification (IPC) or national classification and IPC G02F1/1335				
Applicant HEWLETT-PACKARD DEVELOPMENT COMPANY L.P. et al				
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 5 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau) a total of 6 sheets, as follows:</p> <p><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>				
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>				
Date of submission of the demand  29.08.2005		Date of completion of this report  07.10.2005		
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465		Authorized Officer  Girardin, F  Telephone No. +49 89 2399-7692		



**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/EP2005/051259

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**Box No. I Basis of the report**

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1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
  - ☐ publication of the international application (under Rule 12.4)
  - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements**\* of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

**Description, Pages**

1-16 as originally filed

**Claims, Numbers**

1-16 received on 29.08.2005 with letter of 22.08.2005

**Drawings, Sheets**

1/26-26/26 as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/figs
- ☐ the sequence listing *(specify)*:
- ☐ any table(s) related to sequence listing *(specify)*:

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/figs
- ☐ the sequence listing *(specify)*:
- ☐ any table(s) related to sequence listing *(specify)*:

\* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/EP2005/051259

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**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

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1. Statement

Novelty (N)	Yes: Claims	1-16
	No: Claims	
Inventive step (IS)	Yes: Claims	1-16
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-16
	No: Claims	

2. Citations and explanations (Rule 70.7):

**see separate sheet**

**Re Item V.**

**1. Cited documents**

The following documents are referred to in this communication:

- D1: PATENT ABSTRACTS OF JAPAN vol. 014, no. 195 (P-1039), 20 April 1990 (1990-04-20) -& JP 02 039086 A (KYOCERA CORP), 8 February 1990 (1990-02-08)
- D2: HOCHBAUM A ET AL: "51.3: Cholesteric Color Filters: optical Characteristics, Light Recycling, and Brightness Enhancement" PROCEEDINGS OF THE SID, 18 May 1999 (1999-05-18), XP007008990 SAN JOSE, CALIFORNIA, USA
- D3: EP-A-1 088 877 (CANON KABUSHIKI KAISHA) 4 April 2001 (2001-04-04)

**2. State of the art**

The state of the art represented by D1, which is regarded as the closest prior art, discloses:

a colour display device comprising:  
a first (11) and a second (12) display substrates being opposed to each other at distance and with an electro-optic material between them; each of the substrates having electrodes on their inner surface, these electrodes overlapping to define pixels;  
a set of first colour filters (17a) on the first substrate and a set of second colour filters (17b) on the second substrate;  
whereby the colour of light transmitted through a pixel is determined by the light transmitted by both the first and the second colour filters that intersect at that pixel (Abstract and Fig.2).

In this device, one colour filter covers two elongated electrodes and the colour filters on the first substrate are aligned substantially parallel to those on the second substrate. The overlap of the pixels defined by the electrodes and the colour filters is only guaranteed by a very precise printing process of the filters.

Therefore, the problem to be solved by this invention is how to simplify the fabrication

process of the device of D1.

**3. Invention**

According to this invention, the problem is solved in the following way:

in claims 1, 10, 14 and 15 the elongated electrodes and the colour filters have the same sizes and shapes and are in register with each other, thereby allowing the use of the colour filters as masks to realise the electrodes. The alignment of pixels and colour filters is always guaranteed.

**4. Novelty and inventive step**

None of the cited documents describe a liquid crystal display in which one colour filter is used on each of the substrates and wherein the elongated electrodes and the colour filters on each substrate are registered and have the same size and shape, the subject-matter of claims 1, 10, 14 and 15 is therefore new in the sense of Article 33(2) PCT.

Furthermore, the skilled person would find no hint in the prior art to use colour filters having the same size and shape as the electrodes in such a display. The subject-matter of claims 1, 10, 14 and 15 is therefore considered to involve an inventive step in the sense of Article 33(2) PCT.

**5. Dependent claims**

Claims 2-9, 11-13 and 16 are dependent on claims 1, 10, 14 or 15 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

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## CLAIMS:

1. A colour display device comprising:

a first display substrate and a second display

5 substrate, said substrates being spaced apart and opposed to each other;

a layer of an electro-optic material between the substrates;

10 a set of elongate parallel first electrodes on an inner surface of the first display substrate and a set of elongate parallel second electrodes on an inner surface of the second display substrate, said second electrodes being aligned substantially orthogonally to said first electrodes;

15 said first electrodes overlapping said second electrodes to define pixels for selectively applying an electric field across at least some of said electro-optic material;

a set of first colour filters on the first display substrate, each of said first colour filters being in register with one of said first electrodes, wherein each of  
20 said first colour filters is of substantially the same size and shape as the electrode with which it is registered;

a set of second colour filters on the second display substrate, each of said second colour filters being in register with one of said second electrodes, wherein each of  
25 said second colour filters is of substantially the same size and shape as the electrode with which it is registered;

30 whereby the colour of light transmitted through a pixel is determined by the light transmitted by both the first colour filter and the second colour filter that overlap at that pixel.

2. A device according to claim 1, wherein said first colour filters comprise at least two different colours selected from

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cyan, magenta and yellow, and wherein said second colour filters comprise at least two different colours selected from cyan, magenta and yellow and selected so that any two-by-two array of pixels contains at least one red, one green and one blue pixel.

3. A device according to claim 1 or claim 2, wherein said first colour filters comprise alternating stripes of yellow and cyan and wherein said second colour filters comprise alternating stripes of yellow and magenta.

4. A device according to claim 1 or claim 2, wherein said first and second colour filters each comprise repeating stripes of cyan, magenta and yellow.

5. A device according to claim 1, wherein said first and second colour filters each comprise stripes of a plurality of colours, and wherein the wavelengths of light transmitted by all of said first colour filters or by all of said second colour filters would if mixed produce substantially white light.

6. A device according to any preceding claim, further including a backlight for illuminating the display, located adjacent to an outer surface of said second display substrate; wherein said second colour filters comprise reflectance filters so that at least some of the light which is not transmitted by said second colour filters will be reflected towards said backlight.

7. A device according to claim 6, wherein said first colour filters comprise absorbing filters, whereby incident light which is not transmitted by said first colour filters will be

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substantially absorbed by said filters.

8. A device according to any preceding claim, wherein each electrode is provided with an associated busbar with which it is in registration and in electrical contact.

9. A device according to any preceding claim, wherein the electro-optic material is a liquid crystal material.

10. A method of manufacturing a colour display device, comprising the steps of:

taking a first display substrate having a set of elongate parallel first electrodes on a surface thereof, each of said first electrodes being in register with a colour filter and a busbar provided on the first display substrate;

taking a second display substrate having a set of elongate parallel second electrodes on a surface thereof, each of said second electrodes being in register with a colour filter and a busbar provided on the second display substrate;

wherein each of said colour filters is of substantially the same size and shape as the electrode with which it is registered;

arranging said first and second display substrates in opposition with the surfaces carrying the electrodes facing inwards and spaced apart, and with the first electrodes aligned substantially orthogonally to the second electrodes to define pixels in regions of overlap for selectively applying an electric field therebetween; and

filling the space between the substrates with an electro-optic material and forming a peripheral seal to retain the electro-optic material;

whereby the colour of light transmitted through a pixel



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will be determined by the light transmitted by both the first colour filter and the second colour filter that overlap at that pixel.

- 5 11. A method according to claim 10, further comprising the step of forming the first display substrate by:

forming said colour filters and said busbars in registration on a surface of a transfer carrier;

- 10 adhering said colour filters and said busbars to a sheet of a translucent glass or plastics material;

removing said transfer carrier;

- forming a translucent conductor layer on said busbars after removal of said transfer carrier, said translucent conductor layer being capable of being rendered substantially non-conductive after exposure to UV light of sufficient intensity and duration;

- 15 illuminating said conductor layer with UV light of sufficient intensity and duration through said sheet so as to cause substantial loss of conductivity in regions of said conductor layer corresponding to spaces between said colour filters;

- 20 thereby forming a plurality of translucent electrode tracks, each of which is in electrical contact with a busbar.

- 25 12. A method according to claim 10, further comprising the step of forming the first display substrate by:

forming said colour filters and said busbars in registration on a surface of a transfer carrier;

- 30 adhering said colour filters and said busbars to a sheet of a translucent glass or plastics material;

removing said transfer carrier;

forming a transparent conductor layer on said busbars after removal of said transfer carrier;

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applying a layer of positive photoresist material to said conductor layer;

illuminating said photoresist material with UV light of sufficient intensity and duration through said display substrate as to effect a chemical change in exposed regions of said photoresist material corresponding to spaces between said light filters;

developing said photoresist so as to remove said photoresist in said exposed regions;

etching said conductor layer in regions where said photoresist has been removed, thereby forming a plurality of transparent electrode tracks, each of which is in electrical contact with a busbar; and

removing remaining photoresist.

13. A method according to claim 12, wherein said surface of said transfer carrier is planar.

14. A colour display device comprising first and second spaced apart display substrates enclosing a layer of an electro-optic material, an inner surface of each substrate being provided with a plurality of elongate parallel electrodes and a plurality of elongate parallel colour filters, each filter being in register with an electrode and each filter being of substantially the same size and shape as the electrode with which it is in register; wherein the electrodes on one of the inner surfaces are aligned substantially orthogonally to those on the other inner surface so that the colour of light transmitted through a location where two colour filters overlap is determined by the light transmitted by both of the filters.

15. A colour liquid crystal display device comprising:

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first and second spaced apart display substrates enclosing a layer of a liquid crystal material, an inner surface of each substrate being provided with a plurality of elongate parallel electrodes each of which is in register  
5 with an elongate colour filter of substantially the same size and shape as the electrode with which it is registered and is provided on the same substrate;

the electrodes on one of the inner surfaces being aligned substantially orthogonally to those on the other  
10 inner surface so that the colour of light transmitted through a location where two colour filters overlap is determined by the light transmitted by both of the filters;

the device including a backlight located adjacent to an outer surface of the second display substrate, and the colour  
15 filters on the second display substrate being reflective colour filters.

16. A device according to claim 15, wherein the colour filters on the first display substrate are absorptive colour  
20 filters.